Roll No:
(To be filled in by the candidate)

## PSG COLLEGE OF TECHNOLOGY, COIMBATORE - 641 004

## SEMESTER EXAMINATIONS,    AUGUST / SEPTEMBER - 2015

## BE / BE (SW) - PRODUCTION ENGINEERING    Semester: 3 / 4

## 12P305    FLUID MECHANICS AND MACHINERY

**Time : 3 Hours**                                    **Maximum Marks : 100**

**INSTRUCTIONS:**

1. Answer **ALL** questions from GROUP – I.
2. Answer any **FOUR** questions from GROUP – II.
3. Answer any **ONE** question from GROUP – III.
4. Ignore the box titled as **"Answers for Group III"** in the Main Answer Book.
5. **Moody's Chart, Fluid properties and Minor loss coefficient tables** are to be brought by the candidate to the exam hall.
6. **Graph Sheet** is to be provided.
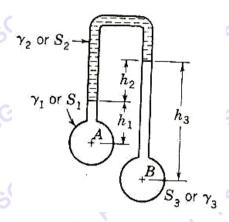7. **State the assumptions wherever necessary while answering Group II and III**

**GROUP - I**                                    **Marks : 10 x 3 = 30**

1. The absolute pressure in a liquid of constant density doubles when the depth is doubled. State true or false and justify the answer.

2. The stream function for a two dimensional flow is given by $\Psi = 2xy$. Calculate the velocity at the point P (2, 3). Find the velocity potential function $\varphi$.

3. Write the meaning of no slip condition.

4. For a 2D flow, Show that the shear stress on a plane is proportional to the velocity gradient perpendicular to the plane.

5. A piping system involves two pipes of different diameter (but of identical length, material, roughness) connected in series. Compare the flow rates and pressure drops in these two pipes. Ignore minor losses.

6. Write the primary dimensions of    a. power  b. universal ideal gas constant $R_u$.

7. Write the significance of blockage ratio in wind tunnel experiments.

8. If velocity distribution in laminar boundary layer over a flat plate is assumed to be a second order polynomial $u = a+by+cy^2$, determine the constants using necessary boundary conditions.

9. Choose whether the following statement is true or false and justify the answer. "At the pump's free delivery efficiency of the pump is zero".

10. What are the primary differences between a positive displacement and dynamic turbo machine?

GROUP - II                      Marks : 4 x 12.5 = 50
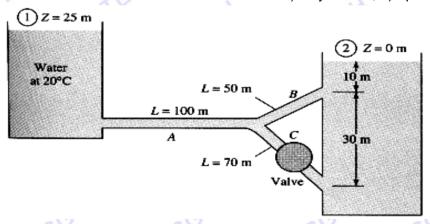
11. a. In the figure, the liquids at A and B are water and
      the manometer liquid is oil (S = 0.80); h1 = 300
      mm; h2 = 20 mm; h3 = 600 mm. a) determine PA-
      PB in Pascal. (b) If PB= 50 kPa and the barometer
      reading is 730 mm of Hg, find the absolute
      pressure at A, in meters of water.                (6.5)



   b. A 1.9 mm diameter tube is inserted into an
      unknown liquid whose density is 960 kg/m$^3$ and it is
      observed that the liquid rises 5 mm in the tube, making a contact angle of 15°.
      Determine the surface tension of the liquid.                                    (6)

12. A velocity field is given by V = (Ax + B)i – Ayj, where A= 3 m$^2$/s and B = 6 m/s. Find the
    equation of the streamline passing through the point (0.3, 0.6) and plot the stream line
    for at least 6 points (take equal increments between x = 0 to 0.5).

13. The stream wise velocity component of a steady, incompressible, laminar, flat plate
    boundary layer of boundary layer thickness δ is approximated by the sine wave profile
    u(y) = U sin(πy / 2δ). Generate expressions for displacement thickness and momentum
    thickness as functions of δ, based on this sine wave approximation.

14. A Francis turbine with an overall efficiency of 75% is required to produce 150 kW at the
    shaft. It is working under a head of 7.62 m. The wheel runs at 150 rpm and the hydraulic
    losses in the turbine are 22% of the available energy. Assuming radial discharge,
    determine (a) guide blade angle (b) vane angle at inlet (c) diameter of the wheel at the
    inlet (d) width of the wheel at the inlet. Take peripheral velocity = 0.26(2gH) $^{1/2}$ and
    $V_{f1}$ = 0.96(2gH) $^{1/2}$.

15. All pipes in figure shown below are 8 cm diameter cast iron. The fluid is water at 20°C.
    Determine the flow rate from reservoir 1 if valve C is a) fully closed; b) open (K = 0.5).

**GROUP - III**                          **Marks : 1 x 20 = 20**

16. A Pelton wheel nozzle with $C_v = 0.97$, is 400m below the water surface of a lake. The jet diameter is 80 mm, the pipe diameter is 0.6 m with a total length of 4 km and friction factor = 0.032. The buckets deflect the jets through 165° and they run at 0.48 times the jet speed. The relative velocity at outlet is reduced by 15% of the relative velocity at the inlet due to bucket friction. Assuming 90% mechanical efficiency, find the flow rate and shaft power developed by the turbine.

17. Derive the momentum integral equation for a flat plate boundary layer. For the following velocity profile, evaluate δ*/δ and θ/δ.

$$\frac{u}{U} = \sqrt{2}\ \frac{y}{\delta} \qquad\qquad 0 < y \le \frac{\delta}{2}$$

$$\frac{u}{U} = \left(2 - \sqrt{2}\right)\frac{y}{\delta} + \left(\sqrt{2} - 1\right) \qquad \frac{\delta}{2} < y \le \delta$$

**/END/**

**FD/JU**